

Building a Complete FSK Modem Using XR-2211 and XR-2206

INTRODUCTION

With the number of digital systems and equipment growing so rapidly, the need for a method of moving data has also become a fast growing field. This application note describes the construction of a modem system using frequency-shift keying, FSK, for serial data transmission. The system utilizes the XR-2206 as a modulator, the XR-2211 as a demodulator, and an XR-084 op amp as a bandpass filter. These three IC's make up a complete working 300 baud, full-duplex, FSK modem.

PRINCIPLES OF OPERATION

Figure 1 shows the block diagram of an FSK system. The complete system is comprised of an answer and originate modem. The answer modem will convert input data to either 1070 Hz or 1270 Hz, and send it to the phone line, while

decoding the 1's and 0's (2025 Hz and 2225 Hz) received from the line. The originate modem simply reverses the frequencies for send and receive. The sine wave modulator will produce two discrete frequencies at its output corresponding to a one or a zero at its data input. The line hybrid will steer these frequencies to the phone line, while causing the received frequencies to go to the bandpass filter and demodulator. This block will, therefore, provide isolation between modulator and demodulator at each end. The bandpass filter is used to remove unwanted signals and noise received from the phone line before they reach the demodulator.

The PLL demodulator will lock onto incoming frequencies at its input, and produce 1's or 0's at its output. The carrier-detect output will produce a low (zero) signal when valid data is being received.

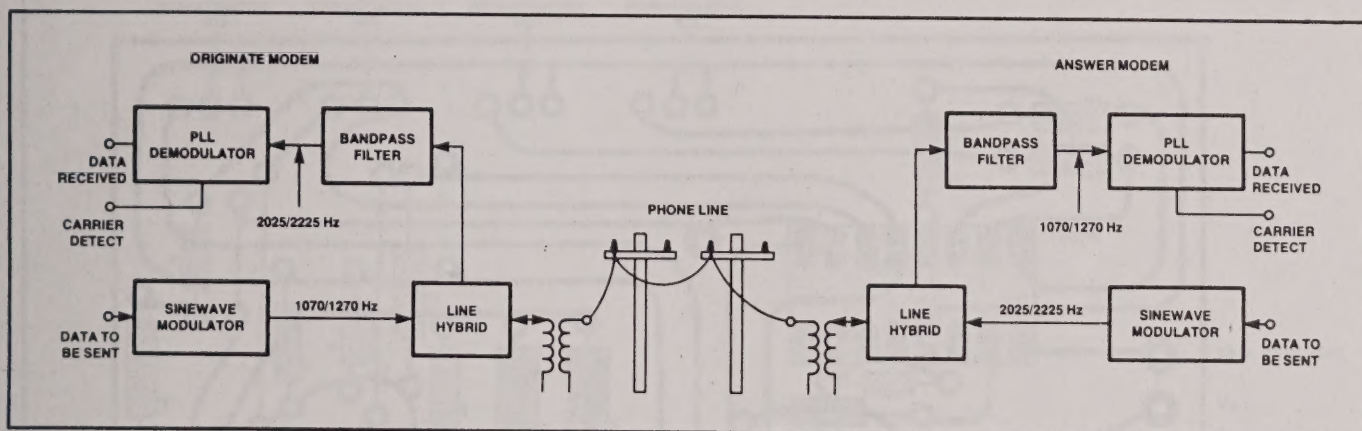


Figure 1. Block Diagram of FSK Modem System

OPERATION AND CALIBRATION

The circuit has been designed for +12V operation. The data inputs accept TTL-compatible signal levels, while the outputs provide 0V to +12V signal levels.

Calibration is done by first adjusting the modulator. With a low-signal on its input, R₂₁ is adjusted for 1270 Hz, or 2225 Hz for originate and answer, respectively. Then with a high-signal in, R₂₂ is adjusted for 1070 Hz or 2025.

The demodulator is easily adjusted by feeding an alternating 1070/1270 Hz or 2025/2225 Hz signal into the modem input in a square wave fashion. The modulating frequency should be 150 Hz, which is one-half the system baud rate

of 300. The baud rate refers to the number of bits per second which can be sent and received. The answer can be used to drive the originate, and vice-versa. R₁₉ is then adjusted for a square wave on the data received output.

R₂₀ is used to set the modulator output level. With the modulator output set at -6 dBm, the system will operate with an input signal range of +10 dBm to -48 dBm.

CIRCUIT CONSTRUCTION

Figures 2 and 3 show the circuit schematic and component layout. One PC board is used for answer or originate, and should use the appropriate components as listed in Table 1.

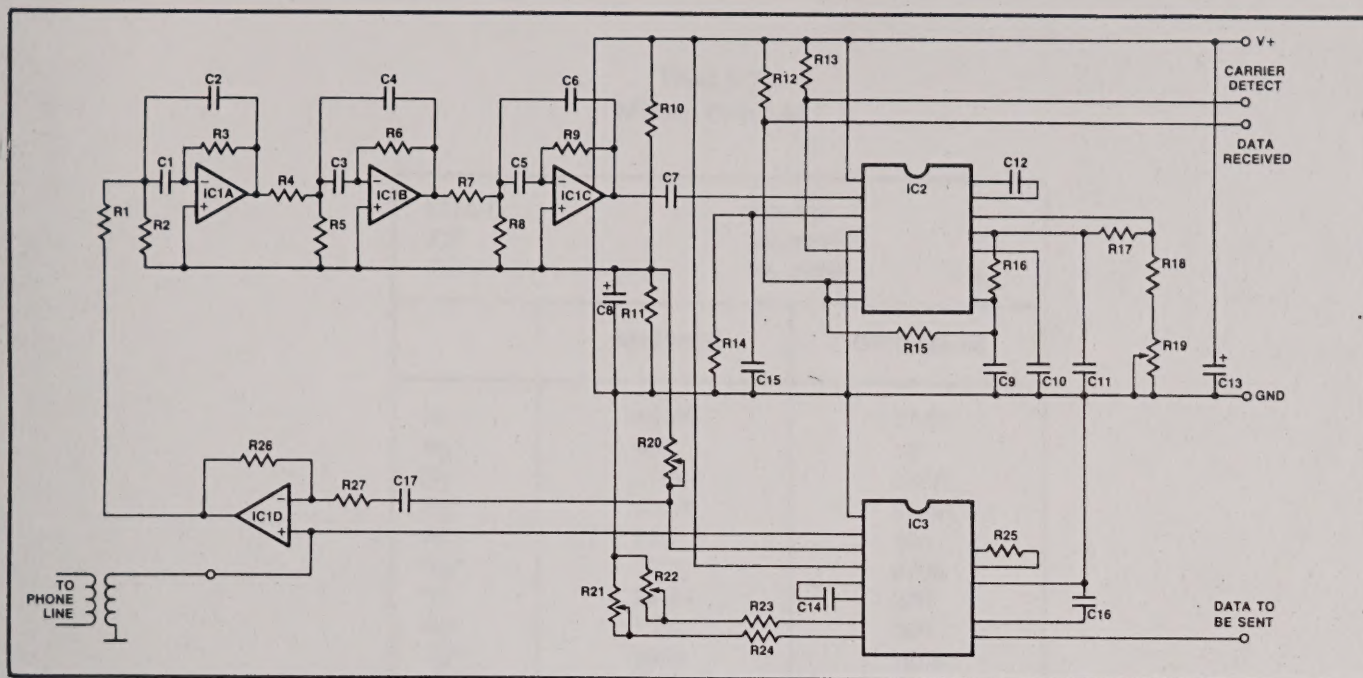


Figure 2. Complete FSK Modem Using XR-2211 and XR-2206

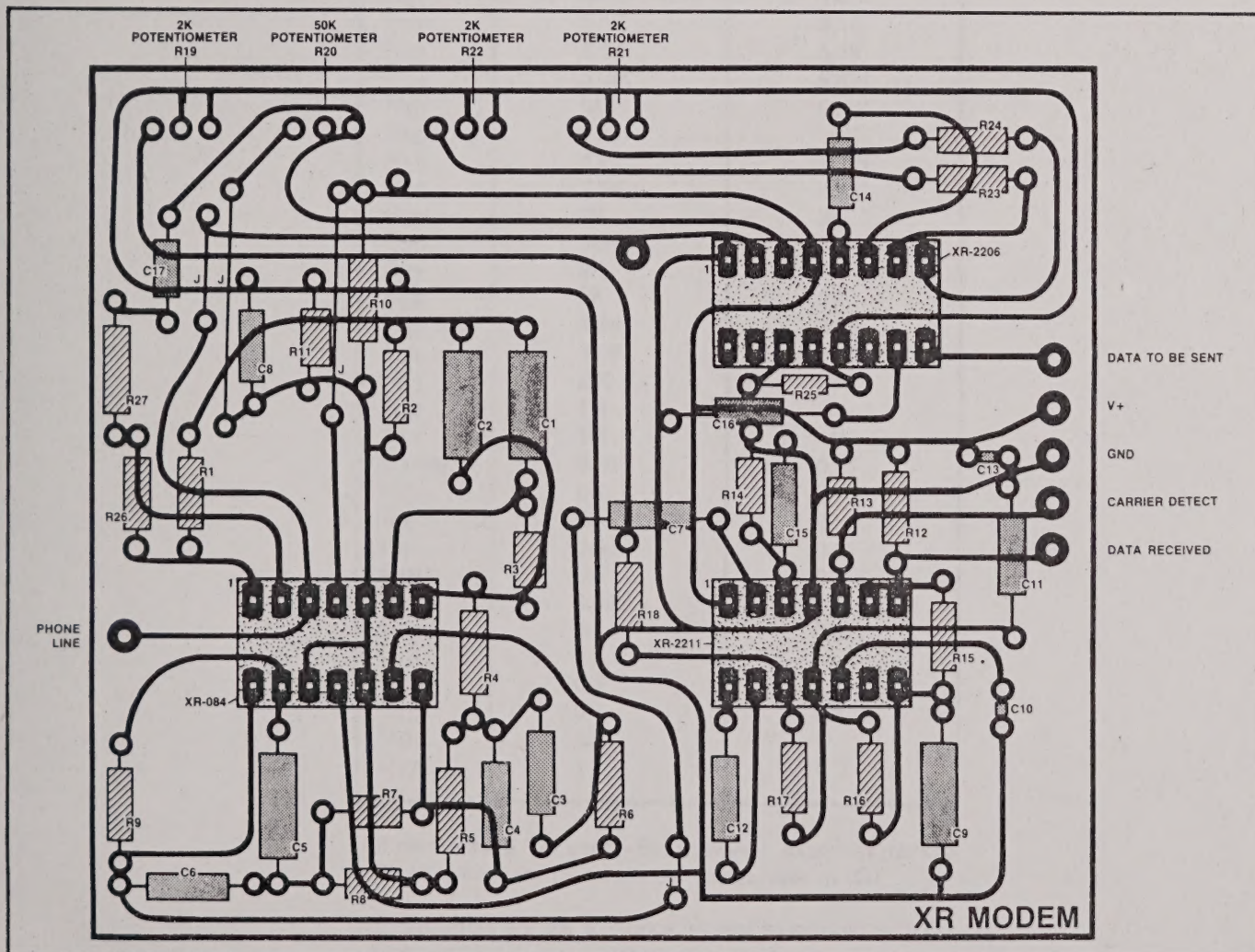


Figure 3. XR Modem Foil Side Shown (Not to Scale.)

TABLE 1.
Modem Parts List

IC1A-D	XR-084
IC2	XR-2211
IC3	XR-2206

	ANSWER	ORIGINATE
R ₁ *	40.2K	47.5K
R ₂ *	499	191
R ₃ *	270K	357K
R ₄ *	60.4K	39.4K
R ₅ *	680	160
R ₆ *	383K	270K
R ₇ *	24.9K	20K
R ₈ *	1.21K	360
R ₉ *	160K	160K
R ₁₀	1K	1K
R ₁₁	1K	1K
R ₁₂	5.1K	5.1K
R ₁₃	5.1K	5.1K
R ₁₄	510K	510K
R ₁₅	510K	510K
R ₁₆	100K	100K
R ₁₇	47K	100K
R ₁₈	7.5K	9.1K
R ₁₉	2K	2K
R ₂₀	50K	50K
R ₂₁	2K	2K
R ₂₂	2K	2K
R ₂₃	3.9K	8.2K
R ₂₄	3.6K	6.8K
R ₂₅	200	200
R ₂₆	1M	1M
R ₂₇	1M	1M
C ₁ -C ₆ *	0.01	0.01
C ₇	0.1	0.1
C ₈	22	22
C ₉	0.01	0.01
C ₁₀	0.1	0.1
C ₁₁	0.022	0.01
C ₁₂	0.1	0.047
C ₁₃	1	1
C ₁₄	0.1	0.1
C ₁₅	0.1	0.1
C ₁₆	1	1
C ₁₇	1	1

All resistors are 1/4 watt -5% tolerance, except as marked with (*) which are 1% tolerance. Values given in (Ω).

All capacitors are 5% tolerance, except as marked with (*) which are 1% tolerance. Values given in μ F.

